(2)

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-274215

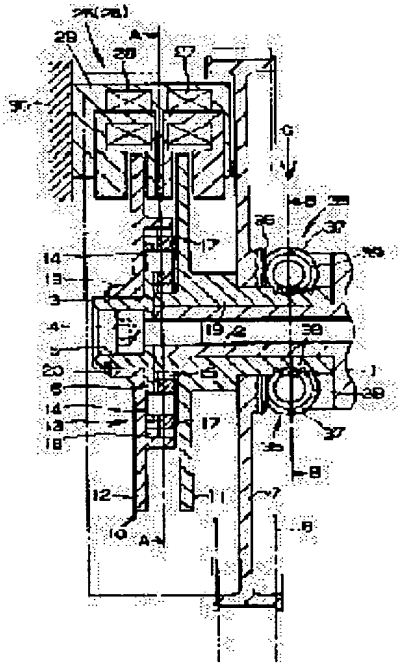
(43)Date of publication of application : 03.10.2000

(51)Int.Cl. F01L 1/34

(21)Application number : 11-078399 (71)Applicant : UNISIA JECS CORP

(22)Date of filing : 23.03.1999 (72)Inventor : IO SHINICHI

(54) VALVE-TIMING CHANGING DEVICE FOR INTERNAL COMBUSTION ENGINE



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a valve timing changing device which can stop the relative turning of a timing pulley and a camshaft at any position and reduce generation of noise.

SOLUTION: This valve timing changing device is provided with a timing pulley 7, a camshaft 1, a second rotor 10, which can rotate and cannot axially move relative to the camshaft 1, and a rotation control means 25, which controls the rotation of the second rotor 10 by electromagnetic force without contacting this second rotor 10. The timing pulley 7, camshaft 1 and second rotor 10 are connected to each other through an irreversible linking means 35, in such a way that torque can be transmitted from the timing pulley 8 to the camshaft 1 and the second rotor 10, but is cannot be transmitted from the second rotor 10 to the timing pulley 7 and camshaft 1, and when relative rotation is generated between the timing pulley 7 and the second rotor 10, the camshaft 1 is rotated relatively with respect to the timing pulley 7.

[Claim(s)]

[Claim 1] Rotatable the 1st body of revolution rotated synchronizing with rotation of an internal combustion engine, the cam shaft which drives an inlet valve or an exhaust valve, and this cam shaft -- receiving -- predetermined include-angle relativity -- And the 2nd body of revolution prepared in shaft-orientations relative-displacement impossible and a roll control means to control rotation of this 2nd body of revolution by electromagnetic force, without contacting this 2nd body of revolution, Three persons of said 1st body of revolution, a cam shaft, and the 2nd body of revolution from the 1st body of revolution possible [torque transmission] to a cam shaft and the 2nd body of revolution From the 2nd body of revolution to the 1st body of revolution and a cam shaft at torque-transmission impossible Moreover, and an irreversible cooperation means to coordinate so that relative rotation of the cam shaft may be carried out to the 1st body of revolution when relative rotation arises between the 1st body of revolution and the 2nd body of revolution, ******** -- an internal combustion engine's valve timing modification equipment characterized by things.

[Claim 2] Valve timing modification equipment of an internal combustion engine according to claim 1 characterized by said irreversible cooperation means consisting of hypoid gears which a bearing is carried out to a cam shaft and gear to the 1st body of revolution, and a worm which is these hypoid gears and really rotatable and gears to the 2nd body of revolution.

[Claim 3] Valve timing modification equipment of an internal combustion engine according to claim 1 characterized by coming to have the coordinated member which has **** which said irreversible cooperation means has a cam shaft and the helical spline which each carries out engagement the 1st body of revolution, and screws in the 2nd body of revolution.

[Claim 4] said 2nd body of revolution -- the rotating disk of two sheets, and the rotating disk of these two sheets -- mutual -- hard flow -- relativity -- the valve timing modification equipment of an internal combustion engine according to claim 1 characterized by consisting of rotation cooperation means to coordinate rotatable.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the valve timing modification equipment for changing the closing motion timing of an inlet valve or an exhaust valve during operation of an internal combustion engine.

[0002]

[Description of the Prior Art] This kind of valve timing modification equipment carries

out relative rotation of the cam shaft which drives an inlet valve or an exhaust valve to the 1st body of revolution, such as a timing pulley which rotates synchronizing with rotation of an internal combustion engine, and has changed the closing motion timing of an inlet valve or an exhaust valve.

[0003] for example, in JP,10-153105,A Axial directional movement is possible to the timing pulley which rotates synchronizing with rotation of an internal combustion engine, and this timing pulley. The migration member which was coordinated with relative rotation impossible and coordinated possible [axial directional movement] through the helical spline to the cam shaft, the drum member screwed in the male screw formed in the periphery of this migration member and this drum member are adsorbed -- with a solenoid the 1st electromagnetism The valve timing modification equipment which is made to move the plate member of which relative rotation with a drum member and a timing pulley is made to stop or cancel in a predetermined location, and this plate member to a halt or a discharge location and which was equipped with the solenoid the 2nd electromagnetism is indicated.

[0004] After it makes it move to the discharge location of relative rotation of a plate member and said valve timing modification equipment enables relative rotation with a drum member and a timing pulley by the solenoid the 2nd electromagnetism, it adsorbs a drum member by the solenoid the 1st electromagnetism, produces relative rotation with the drum member and migration member which were coordinated by ****, and moves a migration member to shaft orientations. By said migration member moving to shaft orientations, relative rotation is produced between the cam shaft coordinated with this migration member in the helical spline, and the timing pulley coordinated with the migration member at relative rotation impossible, and valve timing is changed by this.

[0005]

[Problem(s) to be Solved by the Invention] If it is in said conventional example, a halt of relative rotation of said plate member with a drum member and a timing pulley is performed by engaging the pawl formed in the plate member, and the pawl formed in the drum member, and, for this reason, the halt location [pulley / a drum member and / timing] of relative rotation turns into a gradual location according to the number of pawls.

[0006] Moreover, in order to face carrying out relative rotation of said cam shaft and timing pulley and to adsorb a drum member by the solenoid the 2nd electromagnetism, there is a possibility that the noise may be made mutually from the place which mechanical contact produces.

[0007] This invention was thought out in view of said conventional actual condition,

and it aims at offering the valve timing modification equipment of the internal combustion engine which can decrease generating of the noise as much as possible while it can stop relative rotation with the 1st body of revolution and the cam shaft which are rotated synchronizing with rotation of an internal combustion engine in the location of arbitration.

[0008]

[Means for Solving the Problem] Rotatable then, the 1st body of revolution which invention according to claim 1 rotates synchronizing with rotation of an internal combustion engine, the cam shaft which drives an inlet valve or an exhaust valve, and this cam shaft -- receiving -- predetermined include-angle relativity -- And the 2nd body of revolution prepared in shaft-orientations relative-displacement impossible and a roll control means to control rotation of this 2nd body of revolution by electromagnetic force, without contacting this 2nd body of revolution, Three persons of said 1st body of revolution, a cam shaft, and the 2nd body of revolution from the 1st body of revolution possible [torque transmission] to a cam shaft and the 2nd body of revolution Moreover, when relative rotation arises from the 2nd body of revolution between the 1st body of revolution and the 2nd body of revolution impossible [torque transmission] in the 1st body of revolution and a cam shaft, it is made the configuration which comes to have an irreversible cooperation means to coordinate so that relative rotation of the cam shaft may be carried out to the 1st body of revolution.

[0009] Moreover, in the configuration of invention according to claim 1, said irreversible cooperation means of invention according to claim 2 is the hypoid gears which a bearing is carried out to a cam shaft and gear to the 1st body of revolution, these hypoid gears, and really rotatable, and it has been carried out to the configuration which it becomes from the worm which gears to the 2nd body of revolution.

[0010] Moreover, invention according to claim 3 has been carried out to the configuration which comes to have the coordinated member which has **** which said irreversible cooperation means has a cam shaft and the helical spline which each carries out engagement the 1st body of revolution, and screws in the 2nd body of revolution in the configuration of invention according to claim 1.

[0011] moreover, invention according to claim 4 -- said 2nd body of revolution -- the rotating disk of two sheets, and the rotating disk of these two sheets -- mutual -- hard flow -- relativity -- it is made the configuration which consists of a rotation cooperation means to coordinate rotatable.

[0012] In this configuration, said 1st body of revolution rotates synchronizing with rotation of an internal combustion engine, and a cam shaft rotates through valve

timing modification equipment. That is, since said irreversible cooperation means has coordinated the 1st body of revolution and a cam shaft from the 1st body of revolution possible [torque transmission] to a cam shaft, a cam shaft rotates in one to the 1st body of revolution. By this, said cam shaft drives an inlet valve or an exhaust valve.

[0013] On the other hand, by carrying out relative rotation of the cam shaft to said 1st body of revolution, the rotation phase of a cam shaft is changed, consequently the closing motion timing of an inlet valve or an exhaust valve is changed.

[0014] Relative rotation of a cam shaft to said 1st body of revolution is performed as follows concretely.

[0015] That is, said 1st body of revolution controls rotation of the 2nd body of revolution by the condition of rotating in one to a cam shaft and the 2nd body of revolution through an irreversible cooperation means, with a roll control means.

[0016] The control coil arranged at the periphery close-attendants side of the 2nd body of revolution specifically constitutes said roll control means, a field is made to act on the eddy current produced in the 2nd body of revolution by energizing to this control coil, and it is possible to control rotation of this 2nd body of revolution to the 2nd body of revolution by [which are a hand of cut and the reverse sense] making it generated torque (damping torque).

[0017] Moreover, it is possible by making the 2nd body of revolution used as the so-called Rota produce torque to control rotation of the 2nd body of revolution by two or more motor coils arranged near the periphery of the 2nd body of revolution constituting said roll control means, and energizing in this motor coil. In this case, by arranging two or more magnets in the predetermined location of said 2nd body of revolution, in addition to a reluctance hose, a synchronous hose is produced, and big torque can be acquired.

[0018] When torque acts on said 2nd body of revolution, since the running torque of this 2nd body of revolution is not transmitted to the 1st body of revolution and a cam shaft by the irreversible cooperation means, it will rotate independently and the 2nd body of revolution will produce relative rotation between the 1st body of revolution. If relative rotation arises between said 1st body of revolution and 2nd body of revolution, an irreversible cooperation means will carry out relative rotation of the 1st body of revolution and the cam shaft.

[0019] That is, according to invention according to claim 2, if torque acts on said 2nd body of revolution, this 2nd body of revolution will carry out relative rotation to a cam shaft, and the worm which gears to the 2nd body of revolution will rotate it. Since said worm is made really rotatable with hypoid gears, when this worm rotates, hypoid gears rotate it. Next, since the bearing of said hypoid gears was carried out to the cam shaft

and they have geared to the 1st body of revolution, when hypoid gears rotate, the 1st body of revolution will rotate and the 1st body of revolution and a cam shaft will carry out relative rotation of them by this. That is, when torque acts on said 2nd body of revolution, a worm and hypoid gears will rotate and the 1st body of revolution and a cam shaft will carry out relative rotation.

[0020] Moreover, according to invention according to claim 3, when torque acts on said 2nd body of revolution, this 2nd body of revolution will carry out relative rotation to a cam shaft. Since the coordinated member which gears to said 2nd body of revolution at this time is connected by the helical spline to the cam shaft, when the 2nd body of revolution rotates, a coordinated member moves it to shaft orientations according to an operation of ****. Moreover, since said coordinated member is connected by the helical spline also to the 1st body of revolution while it is connected by the helical spline to the cam shaft, when a coordinated member moves to shaft orientations, the 1st body of revolution and a cam shaft will carry out relative rotation of it. That is, when torque acts on said 2nd body of revolution, a coordinated member will move to shaft orientations and the 1st body of revolution and a cam shaft will carry out relative rotation.

[0021] For this reason, by carrying out relative rotation of the cam shaft to said 1st body of revolution, the rotation phase of a cam shaft will be changed and the closing motion timing of the inlet valve or exhaust valve driven by the cam shaft is changed by this.

[0022] Moreover, since relative rotation will not arise between the 1st body of revolution and the 2nd body of revolution if the roll control of the 2nd body of revolution by the roll control means is stopped as said roll control means has given torque to the 2nd body of revolution (i.e., as the 1st body of revolution and a cam shaft are carrying out relative rotation), relative rotation with the 1st body of revolution and a cam shaft is stopped immediately. Said 1st body of revolution and cam shaft will be held by this in the mid-position of relative rotation, and will carry out [a cam shaft] closing motion control by it to the timing of a request of the inlet valve or exhaust valve driven by this cam shaft.

[0023] In this case, the mid-position [cam shaft / said / 1st body of revolution and cam shaft] of relative rotation is a location obtained by stopping control of the 2nd body of revolution by the roll control means, and will be obtained by the stepless story.

[0024] Moreover, since it is obtained by controlling relative rotation with said 1st body of revolution and cam shaft by electromagnetic force, without a roll control means contacting this 2nd body of revolution in rotation of the 2nd body of revolution, mechanical contact does not arise between a roll control means and the 2nd body of

revolution, and generating of the noise is controlled advantageously.

[0025] Therefore, while being able to stop relative rotation with the 1st body of revolution and the cam shaft which are rotated synchronizing with rotation of an internal combustion engine in the location of arbitration, the valve timing modification equipment of the internal combustion engine which can decrease generating of the noise as much as possible is obtained.

[0026] In addition, if it is in invention according to claim 2, since said irreversible good cooperation means is formed with two or more gearings, rotational resistance in case this irreversible cooperation means operates can be decreased successively as much as possible.

[0027] Moreover, it enables it for the coordinated member of said irreversible cooperation means to shorten a radial dimension, and to attain a miniaturization, since it can form in the shape of [in which **** screwed in the helical spline and the 2nd body of revolution which the helical spline which gears to a cam shaft is formed in an inner circumference side, and gear to the 1st body of revolution at a periphery side was formed] a cylindrical shape if it is in invention according to claim 3.

[0028] Moreover, if it is in invention according to claim 4, by controlling alternatively rotation of the rotating disk of two sheets as said 2nd body of revolution, the direction of the relative rotation to the cam shaft of the 2nd body of revolution will be chosen, the direction [cam shaft / the 1st body of revolution and] of relative rotation will be chosen, and a cam shaft can be easily rotated in the direction of a tooth lead angle, or the direction of a lag.

[0029]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained in full detail based on a drawing.

[0030] The explanatory view which drawing 1 carries out the cross section of the important section of the valve timing modification equipment of the internal combustion engine which shows the gestalt of operation of this invention, and is shown, and drawing 2 are [the B-B line sectional view of drawing 1 and drawing 4 of the A-A line sectional view of drawing 1 and drawing 3] the direction view Figs. of C of drawing 1 .

[0031] In drawing, 1 is the cam shaft which drives an internal combustion engine's inlet valve or exhaust valve, and is a cam shaft which drives an inlet valve in the gestalt of this operation.

[0032] Said cam shaft 1 is supported free [rotation] by the bearing fixed to the cylinder head outside drawing. Moreover, in drawing 1 , the cam is formed in the radical management (not shown) of the right-hand side cam shaft 1 rather than the bearing

outside said drawing, and the closing motion drive of the inlet valve outside drawing is carried out by this cam.

[0033] The narrow diameter portion 2 is formed in the edge of said cam shaft 1, and the auxiliary member 3 is being fixed to the end face of this narrow diameter portion 2 with the bolt 4. Said auxiliary member 3 is equipped with a cam shaft 1, the boss section 5 formed in this alignment, and the flange 6 annular section prolonged in the method of the outside of radial from this boss section 5.

[0034] 7 is the 1st body of revolution rotated synchronizing with an internal combustion engine, and this 1st body of revolution 7 is a timing pulley by which a rotation drive is carried out with an internal combustion engine's crankshaft (not shown) in the gestalt of this operation. The timing belt 8 driven with the crankshaft outside drawing is wound around said timing pulley 7.

[0035] 10 is the 2nd body of revolution. said 2nd body of revolution 10 — the gestalt of this operation — setting — the 1st rotating disk 11 and the 2nd rotating disk 12, and these 1st rotating disks 11 and the 2nd rotating disk 12 — mutual — hard flow — relativity — from a rotation cooperation means 13 to coordinate rotatable — becoming — a cam shaft 1 — receiving — predetermined include-angle relativity — it is rotatable and is prepared in shaft-orientations relative-displacement impossible.

[0036] That is, the bearing of the rotation of said 1st rotating disk 11 and 2nd rotating disk 12 is made free to each of the shaft 14 of the pair implanted in the flange 6 of the auxiliary member 3, and the shaft 14 of this pair, and they are coordinated by the rotation cooperation means 13 constituted with the gearing 17 which meshes to the internal tooth 16 formed in the external tooth 15 formed in the 1st rotating disk 11, and the 2nd rotating disk 12.

[0037] Moreover, while the bearing of the rotation of the boss section 18 of said 1st rotating disk 11 is made free to the narrow diameter portion 2 of a cam shaft 1 and the bearing of the boss section 19 of the 2nd rotating disk 12 is carried out to the boss section 5 of the auxiliary member 3 By carrying out a bearing to the narrow diameter portion 2 of a cam shaft 1, the 1st body of revolution 11 Relative displacement of shaft orientations is prevented by the shoulder and the auxiliary member 3 of a cam shaft 1, and migration of shaft orientations is prevented with the snap ring 20 which formed the 2nd body of revolution 12 in the periphery of the flange 6 of the auxiliary member 3, and the boss section 5. By this the 1st rotating disk 11 and the 2nd rotating disk 12 10, i.e., the 2nd body of revolution, — a cam shaft 1 — receiving — predetermined include-angle relativity — it is rotatable and has become shaft-orientations relative-displacement impossible.

[0038] Moreover, the 1st rotating disk 11 and the 2nd rotating disk 12 which

constitute said 2nd body of revolution 10 are formed from an electrical conducting material, and are preferably formed from a non-magnetic material with small electric resistance, such as aluminum.

[0039] 25 is a roll control means to control rotation of said 2nd body of revolution 10. Said roll control means 25 is constituted by the control coil 26 arranged near the periphery of the 2nd body of revolution 10, and this control coil 26 consists of the 1st control coil 27 and the 2nd control coil 28 which have been arranged near [each] the periphery of the 1st rotating disk 11 and the 2nd rotating disk 12 in the gestalt of this operation.

[0040] It is fixed to the fixed end 30 by the side of an engine by the holder 29, the control coil 26 as said roll control means 25 makes a field act on the eddy current produced in the 2nd body of revolution 10 by energizing to this control coil 26, and it is possible to control rotation of this 2nd body of revolution 10 to the 2nd body of revolution 10 by [which are a hand of cut and the reverse sense] making it generated torque (damping torque). Therefore, said roll control means 25 is controllable at electromagnetic force, without contacting this 2nd body of revolution 10 in rotation of the 2nd body of revolution 10.

[0041] Moreover, the control coil 26 as said roll control means 25 is driven through the control unit outside drawing into which the various signals which show an internal combustion engine's operational status are inputted.

[0042] The bearing of the rotation of the timing pulley 7 as said 1st body of revolution is made free to the periphery of the boss section 18 of the 1st rotating disk 11 which constitutes the 2nd body of revolution 10, and three persons of the timing pulley 7 as this 1st body of revolution, a cam shaft 1, and the 2nd body of revolution 10 are coordinated with the irreversible cooperation means 35.

[0043] Said irreversible cooperation means 35 three persons of the timing pulley (the 1st body of revolution) 7, a cam shaft 1, and the 2nd body of revolution 10 From the timing pulley 7 possible [torque transmission] to a cam shaft 1 and the 2nd body of revolution 10 Moreover, when relative rotation arises from the 2nd body of revolution 10 between the timing pulley 7 and the 2nd body of revolution 10 impossible [torque transmission] in the timing pulley 7 and a cam shaft 1, it has coordinated so that relative rotation of the cam shaft 1 may be carried out to the timing pulley 7.

[0044] That is, in the gestalt of this operation, the bearing of said irreversible cooperation means 35 is carried out to a cam shaft 1, and it is the hypoid gears 37 which gear to **** 36 formed in the timing pulley 7, these hypoid gears 37, and really rotatable, and consists of worms 39 which gear to the worm wheel 38 formed in the 2nd body of revolution 10. Said hypoid gears 37 and worm 39 are connected in one

with the shaft 40, and the bearing of the rotation is made free to the bearing material 41 by which this shaft 40 was fixed to the cam shaft 1.

[0045] In this configuration, when the signal which maintains the maximum lag condition at the control coil 26 as a roll control means 25 from the control unit outside the time of an internal combustion engine's starting or drawing is inputted, the relative position of the cam shaft 1 to the timing pulley 7 is located in the maximum lag location, and this cam shaft 1 carries out the closing motion drive of the inlet valve to predetermined timing. That is, since said irreversible cooperation means 35 has coordinated the timing pulley 7 and the cam shaft 1 from the timing pulley 7 possible [torque transmission] to a cam shaft 1, a cam shaft 1 rotates in one to the timing pulley 7. When said cam shaft 1 rotates, an internal combustion engine's inlet valve will drive and closing motion control will be carried out.

[0046] Next, when tooth-lead-angle control is carried out, by carrying out relative rotation of the cam shaft 1 to the timing pulley 7, the rotation phase of a cam shaft 1 is changed, consequently the closing motion timing of an inlet valve is brought forward.

[0047] Relative rotation of a cam shaft 1 to said timing pulley 7 is performed as follows concretely.

[0048] That is, rotation of the 2nd body of revolution 10 is controlled by the condition that said timing pulley 7 is rotating in one to a cam shaft 1 and the 2nd body of revolution 10 through the irreversible cooperation means 35, with the roll control means 25.

[0049] Specifically, it energizes and controls through the control unit outside drawing to the control coil 26 as a roll control means 25 arranged at the periphery close-attendants side of said 2nd body of revolution. that is, a field is acted on the eddy current produced in the 2nd body of revolution 10 by energizing to said control coil 26 -- making -- the 2nd body of revolution 10 -- the torque (damping torque) of a hand of cut and the reverse sense -- it is made to be generated and this controls rotation of the 2nd body of revolution 10.

[0050] When torque acts on said 2nd body of revolution 10, since the running torque of this 2nd body of revolution 10 is not transmitted to the timing pulley 7 and a cam shaft 1 by the irreversible cooperation means 35, it will rotate independently and the 2nd body of revolution 10 will produce relative rotation between the timing pulleys 7. If relative rotation arises between said timing pulley 7 and 2nd body of revolution 10, the irreversible cooperation means 35 will carry out relative rotation of the timing pulley 7 and the cam shaft 1.

[0051] An exciting current is energized in detail to the 1st control coil 27 prepared corresponding to the 1st rotating disk 11 of said 2nd body of revolution 10, and

damping torque is made to act on the 1st rotating disk 11. When torque acts on the 1st rotating disk 11 of said 2nd body of revolution 10, this 1st rotating disk 11 will carry out relative rotation to a cam shaft 1. At this time, the bearing of the 2nd rotating disk 12 coordinated through the rotation cooperation means 13 to said 1st rotating disk 11 is carried out to boss section 5 periphery of the auxiliary member 3 attached in the cam shaft 1, and it rotates to hard flow to the 1st rotating disk 11.

[0052] Since the worm wheel 38 prepared in the 1st rotating disk 1 when the 1st rotating disk 11 of said 2nd body of revolution 10 carried out relative rotation to a cam shaft 1 rotates, the worm 39 which gears to this worm wheel 38 rotates. Since said worm 39 is made really rotatable with hypoid gears 37, when this worm 39 rotates, hypoid gears 37 rotate it.

[0053] Since the bearing of said hypoid gears 37 was carried out to the cam shaft 1 (fixed bearing material 41) and they have geared to **** 36 of the timing pulley 7, when hypoid gears 37 rotate, the timing pulley 7 will rotate and the timing pulley 7 and a cam shaft 1 will carry out relative rotation of them by this. That is, when torque acts on said 2nd body of revolution 10 (the 1st rotating disk 11), a worm 39 and hypoid gears 37 will rotate, and the timing pulley 7 and a cam shaft 1 will carry out relative rotation.

[0054] Said timing pulley 7 and cam shaft 1 carry out relative rotation, the rotation phase of a cam shaft 1 is changed in the direction of a tooth lead angle by this, tooth-lead-angle control of the cam shaft 1 is carried out, and the timing of closing motion of the inlet valve driven by this cam shaft 1 is brought forward.

[0055] Next, while canceling the energization to the 1st control coil 27 prepared corresponding to the 1st rotating disk 11 of said 2nd body of revolution 10, an exciting current is energized to the 2nd control coil 28 prepared corresponding to the 2nd rotating disk 12, and damping torque is made to act on the 2nd rotating disk 12. When torque acts on the 2nd rotating disk 12 of said 2nd body of revolution 10, this 2nd rotating disk 12 will carry out relative rotation to a cam shaft 1. At this time, the bearing of the 1st rotating disk 11 coordinated through the rotation cooperation means 13 to said 2nd rotating disk 12 is carried out to narrow diameter portion 2 periphery of a cam shaft 1, and it rotates to hard flow in the 2nd rotating disk 12.

[0056] The rotation direction of the 1st rotating disk 11 when torque acts on said 2nd rotating disk 12 turns into a hand of cut when torque acts on the 1st rotating disk 11 with hard flow, and the direction of [at the time of said tooth-lead-angle control] will carry out relative rotation of the 1st rotating disk 11 to hard flow to a cam shaft 1.

[0057] When the 1st rotating disk 11 of said 2nd body of revolution 10 carries out relative rotation to a cam shaft 1, a worm 39 and hypoid gears 37 will rotate, and the

timing pulley 7 will rotate.

[0058] Said timing pulley 7 and cam shaft 1 will carry out relative rotation, the rotation phase of a cam shaft 1 will be changed in the direction of a lag by this, lag control of the cam shaft 1 will be carried out, and the timing of closing motion of the inlet valve driven by this cam shaft 1 will be delayed.

[0059] Moreover, if said 2nd body of revolution 10 (the 1st rotating disk 11) stops the energization to a control coil 26 from the control unit outside drawing by the condition of rotating in the direction of a tooth lead angle, or the direction of a lag to a cam shaft 1, the 2nd body of revolution 10 will be held to a cam shaft 1 in the in-between location of relative rotation. Said timing pulley 7 and cam shaft 1 will be held by this in the in-between location of relative rotation, and a cam shaft 1 will control by desired timing the inlet valve driven by this cam shaft 1.

[0060] In this case, it is the location obtained by stopping control of the 2nd body of revolution 10 of the timing pulley 7 as said 1st body of revolution, and a cam shaft 1 according [the mid-position of relative rotation] to the roll control means 25, and will be obtained by the stepless story.

[0061] Moreover, since it is obtained by controlling relative rotation with the timing pulley 7 as said 1st body of revolution, and a cam shaft 1 by electromagnetic force, without the roll control means 25 contacting this 2nd body of revolution 10 in rotation of the 2nd body of revolution 10, mechanical contact does not arise between the roll control means 25 and the 2nd body of revolution 10, and generating of the noise is controlled advantageously.

[0062] Therefore, while being able to stop relative rotation with the 1st body of revolution (timing pulley 7) and the cam shaft 1 which are rotated synchronizing with rotation of an internal combustion engine in the location of arbitration, the valve timing modification equipment of the internal combustion engine which can decrease generating of the noise as much as possible is obtained.

[0063] In addition, since said irreversible good cooperation means 35 is formed with two or more gearings, rotational resistance in case this irreversible cooperation means 35 operates can be decreased successively as much as possible.

[0064] moreover, said 2nd body of revolution 10 — the rotating disks 11 and 12 of two sheets, and the rotating disks 11 and 12 of these two sheets — mutual — hard flow — relativity — since it constitutes from a rotation cooperation means 13 to coordinate rotatable, the direction of the relative rotation to the cam shaft 1 of the 2nd body of revolution 10 is chosen by controlling alternatively rotation of the rotating disks 11 and 12 of two sheets. For this reason, the direction of relative rotation of said timing pulley 7 and cam shaft 1 will be chosen, and a cam shaft 1 can be easily rotated

in the direction of a tooth lead angle, or the direction of a lag.

[0065] Drawing 5 is the drawing in which the gestalt of another operation of this invention is shown, and the gestalt of this operation is the configuration of the irreversible cooperation means 35 the gestalt of said operation, and the changing place, and it is the point that this irreversible cooperation means 35 is equipped with the coordinated member 45.

[0066] Namely, said irreversible cooperation means 35 is equipped with the approximately cylindrical coordinated member 45, the helical spline 46 is formed in an inner circumference side, and, as for this coordinated member 45, the helical spline 47 and **** (male screw) 48 are formed in the periphery side. Moreover, the helical spline 47 by the side of a periphery gears to the helical spline 50 formed in the timing pulley 7, and said coordinated member 45 is screwed in the **** (female screw) 51 which the male screw 48 formed in the 1st rotating disk 11 of the 2nd body of revolution 10 while the helical spline 46 by the side of the inner circumference of this coordinated member 45 gears to the helical spline 49 formed in the narrow diameter portion 2 of a cam shaft 1.

[0067] As for the screw thread (female screw) 51 of the 1st rotating disk 11 which is formed in the periphery of said coordinated member 45 and which it ****s (male screw) and is screwed in 48 and this, the square thread is adopted comparatively preferably [of a low pitch].

[0068] In addition, since other configurations are the same as that of the gestalt of said operation, they give the same sign to the same component, and omit the overlapping explanation.

[0069] According to this configuration, when torque acts on said 2nd body of revolution 10 (the 1st body of revolution 11 or the 2nd body of revolution 12), this 2nd body of revolution 10 will carry out relative rotation to a cam shaft 1. Since the coordinated member 45 which gears to said 2nd body of revolution 10 at this time is connected by the helical splines 46 and 49 to the cam shaft 1, when the 2nd body of revolution 10 rotates, the coordinated member 45 moves it to shaft orientations according to an operation of **** 48 and 51. Moreover, since said coordinated member 45 is connected by the helical splines 47 and 50 also to the timing pulley 7 while it is connected by the helical splines 46 and 49 to the cam shaft 1, when the coordinated member 45 moves to shaft orientations, the timing pulley 7 and a cam shaft 1 will carry out relative rotation of it. That is, when torque acts on said 2nd body of revolution 10, the coordinated member 45 will move to shaft orientations, and the timing pulley 7 and cam shaft 1 as the 1st body of revolution will carry out relative rotation.

[0070] For this reason, by carrying out relative rotation of the cam shaft 1 to the timing pulley 7 as said 1st body of revolution, the rotation phase of a cam shaft 1 will be changed and the closing motion timing of the inlet valve driven by the cam shaft 1 is changed by this.

[0071] Moreover, if said 2nd body of revolution 10 (the 1st rotating disk 11) stops the energization to a control coil 26 from the control unit outside drawing by the condition of rotating in the direction of a tooth lead angle, or the direction of a lag to a cam shaft 1, the 2nd body of revolution 10 will be held to a cam shaft 1 in the in-between location of relative rotation. Said timing pulley 7 and cam shaft 1 will be held by this in the in-between location of relative rotation, and a cam shaft 1 will control by desired timing the inlet valve driven by this cam shaft 1.

[0072] Therefore, while being able to stop relative rotation with the 1st body of revolution (timing pulley 7) and the cam shaft 1 which are rotated synchronizing with rotation of an internal combustion engine like the gestalt of said operation in the location of arbitration, the valve timing modification equipment of the internal combustion engine which can decrease generating of the noise as much as possible is obtained.

[0073] In addition, since the coordinated member 45 of said irreversible cooperation means 35 is formed in the shape of [in which the helical spline 46 which gears to a cam shaft 1 was formed in the inner circumference side, and the **** 48 screwed in the helical spline 47 and the 2nd body of revolution 10 which gear to the timing pulley 7 at a periphery side was formed] a cylindrical shape, it shortens a radial dimension and becomes possible [attaining a miniaturization].

[0074] As mentioned above, although the gestalt of operation was explained based on the drawing, a concrete configuration is not restricted to the gestalt of this operation, and can be changed in the range which does not deviate from the summary of invention. For example, although the gestalt of the operation which carries out tooth-lead-angle control of said cam shaft 1 was described, it is also possible to adopt it as the valve timing modification equipment which carries out lag control.

[0075]

[Effect of the Invention] As mentioned above, as explained to the detail, while being able to stop relative rotation with the 1st body of revolution and the cam shaft which are rotated synchronizing with rotation of an internal combustion engine in the location of arbitration according to this invention, the valve timing modification equipment of the internal combustion engine which can decrease generating of the noise as much as possible is obtained.

[Brief Description of the Drawings]

[Drawing 1] It is the explanatory view in which carrying out the cross section of the important section of the valve timing equipment of the internal combustion engine which shows the gestalt of operation of this invention, and showing it.

[Drawing 2] It is the A-A line sectional view of drawing 1 .

[Drawing 3] It is the B-B line sectional view of drawing 1 .

[Drawing 4] It is the direction view Fig. of C of drawing 1 .

[Drawing 5] It is the same drawing as drawing 1 in which the gestalt of another operation of this invention is shown.

[Description of Notations]

1 Cam Shaft

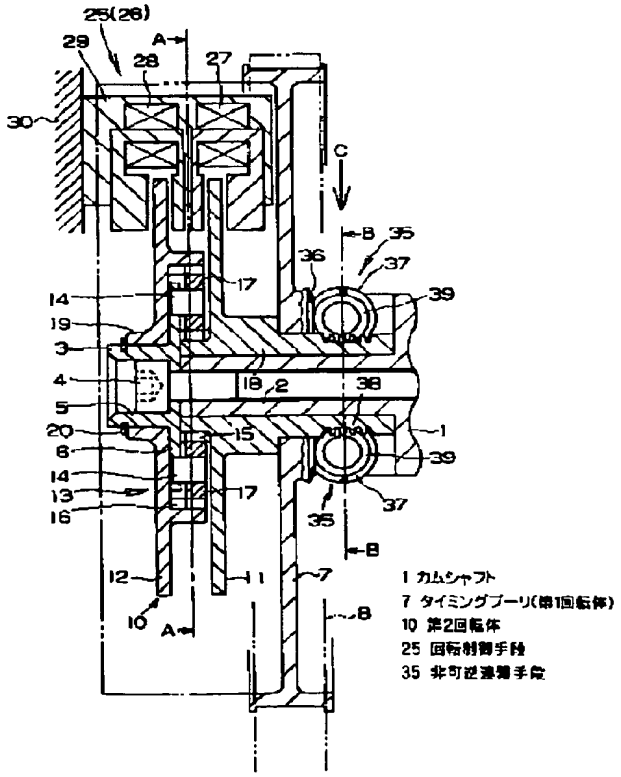
7 Timing Pulley (1st Body of Revolution)

10 2nd Body of Revolution

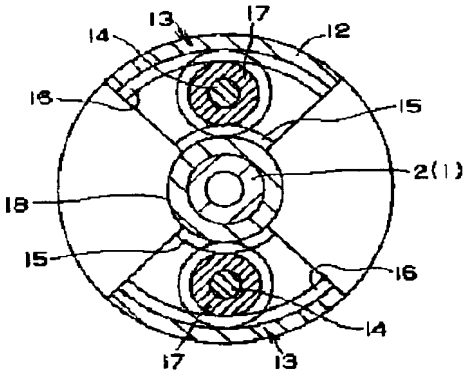
25 Roll Control Means

35 Irreversible Cooperation Means

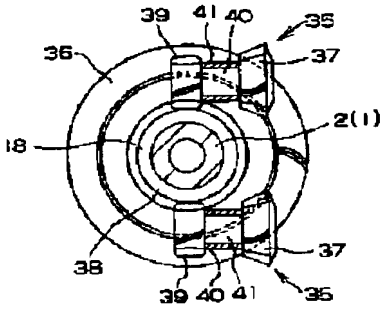
[Drawing 1]



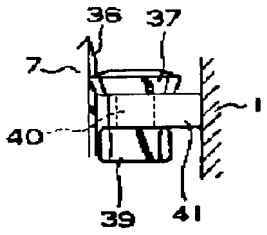
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Drawing 5]